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A TILTED-UP, BEVELED-OFF ATOLL

WHAT WOULD A TILTED-UP, BEVELED-OFF ATOLL LOOK LIKE?

IF an atoll were tilted up by deformational forces and then beveled off to low relief by degradational processes, its understructure would be laid bare. If the atoll reef had been formed on the margin of a shallow platform cut across a stationary, worn-down, deeply weathered volcanic island by the waves of the lowered and chilled ocean in the Glacial epochs of the Glacial period, according to Daly's Glacial-control theory, the revealed understructure would consist chiefly of volcanic rocks under a small thickness of lagoon deposits. If the atoll reef had been formed on the margin of a submarine bank that had been built up to small depth by pelagic calcareous deposits over a deep, non-subsiding volcanic foundation, according to the Rein-Murray theory, the tilted and beveled understructure should give evidence of such an origin by showing chiefly deep-water calcareous deposits on a volcanic mass of submarine eruption. If the atoll reef and its enclosed lagoon deposits had been built up to great thickness on a slowly subsiding volcanic island of subaerial eruption and erosion, according to Darwin's theory, the beveled understructure would declare this origin by showing chiefly shallow-water calcareous deposits above a volcanic base.

To make the latter case specific, let it be assumed that the original foundation of the atoll was a mountainous volcanic island of oval outline, about 50 miles long. If such an island sank slowly, while a barrier reef grew up around it and calcareous lagoon deposits were laid down in the "moat" enclosed by the barrier, until the island was wholly submerged, the barrier reef would become an atoll reef, as in Fig. 1. If such an atoll were tilted up at its southwestern end, and if the uptilted area were degraded to moderate or low relief, as in Fig. 2, the understructure would be well revealed. The upper beds would consist of lagoon limestones with occasional lagoon reefs, originally encircled by the marginal atoll reef; and the volcanic foundation would be laid bare beneath the limestones, if the uplift and the following degradation were of great enough measure. If a central area of the foundation were shown, the calcareous beds would there overlie the summits of the dissected volcanic range unconformably; but if only a marginal part of the foundation were shown, calcareous beds might there alternate in approximate conformity with tuffs and agglomerates, either because these volcanic

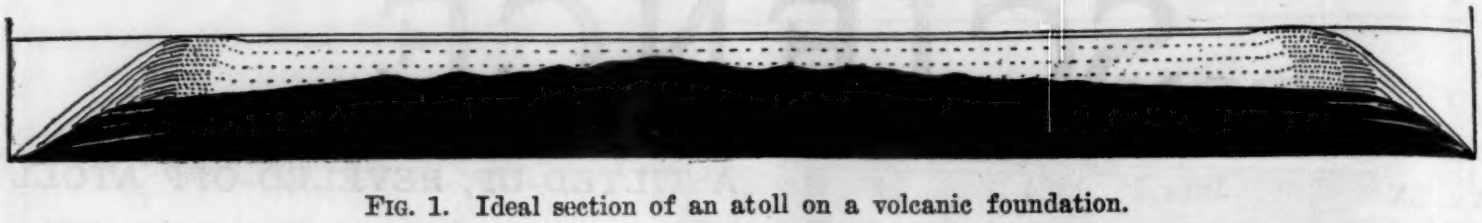

FIG. 1. Ideal section of an atoll on a volcanic foundation.

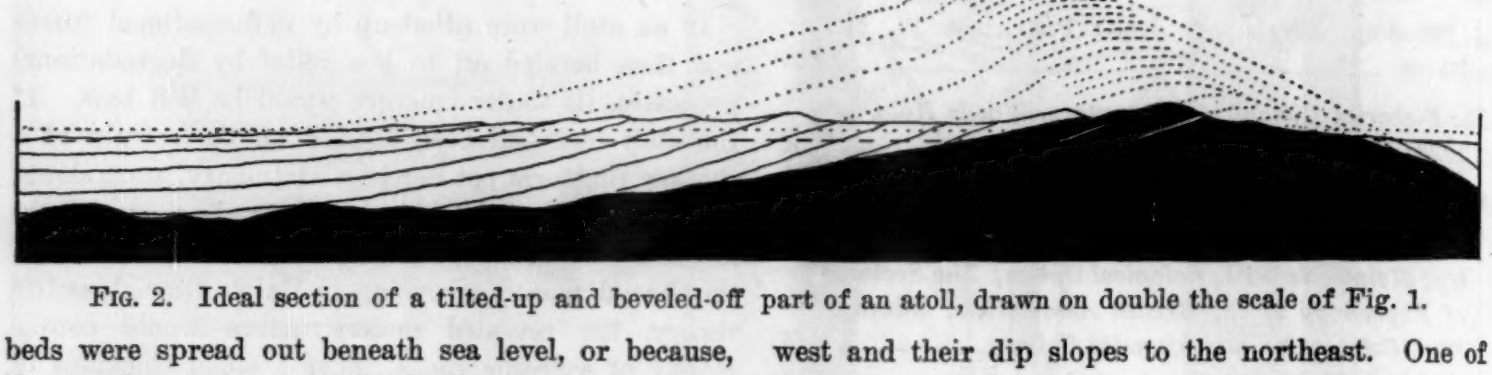

FIG. 2. Ideal section of a tilted-up and beveled-off part of an atoll, drawn on double the scale of Fig. 1.

beds were spread out beneath sea level, or because, if spread out above sea level, they were submerged by the subsidence of the island before they were much eroded during a long dormant interval when no eruptions occurred.

AN ACTUAL ISLAND THAT APPEARS TO BE A TILTED-UP AND BEVELED-OFF ATOLL

Now there is a certain island measuring about 12 miles across, which has been examined by several geologists and which exhibits, in a series of volcanic and calcareous beds inclined to the northeast and at least 8,000 feet in total thickness, a structure very much like that just inferred for a tilted-up and beveled-off atoll built up from a subsiding foundation. Its southwestern or basal quarter is occupied by volcanic rocks, including lavas, agglomerates and ash beds, which are as a rule inclined moderately to the northeast, and which are overlaid in apparent conformity by a series of cherts, tuffs and limestones, several thousand feet in total thickness, dipping 10° or 15° northeastward and occupying the remaining three-fourths of the island. The basal district of relatively resistant volcanic rocks, stripped of its former calcareous cover, is worn down to submountainous relief; the highest summit is near the southwestern coast; it is largely composed of deeply lying lavas and has an altitude of 1,330 feet. The overlying volcanic beds more to the northeast, composed largely of agglomerates and tuffs, are etched out in a series of discontinuous cuestas, trending northwest-southeast, with strong slopes on their outcrop side and gentler slopes on their dip side.

The larger district of calcareous and other strata is reduced to low relief, except that its cherts and its more resistant limestones, both occurring in discontinuous beds of lens-like form, surmount the worn-down lowlands of weaker tuffs and marls in discontinuous cuestas, again with their scarps to the southwest and their dip slopes to the northeast. One of the cuestas, formed on a low-lying chert bed, rises with a length of two or three miles near the submountainous volcanic district, from which it is separated by a well-defined subsequent valley, evidently excavated along a series of weak strata, presumably tuffs. The limestone cuestas rise in the northeastern third of the island, and are separated from the chert cuesta by a rather broad medial lowland which traverses the island obliquely from coast to coast. So much for the form of the island: let its origin as indicated by its structure be next inquired into.

THE BASAL VOLCANIC ROCKS

The southwestern district appears to represent the marginal part of a volcanic island that was built up chiefly by subaerial eruptions; the lower agglomerates are interpreted as subaerial deposits: the lower tuffs contain no marine fossils as far as known, and are only rarely interbedded with thin calcareous lenses holding marine fossils. The island thus formed must have subsided during the later stages of its volcanic activity at least, for according to the latest and fullest geological report (1923), the higher volcanic beds, a thousand feet or more in thickness, include "water deposited and stratified tuffs . . . . with intercalcations of [locally developed] marine and fresh water limestone. . . . . At intervals during the deposition of these beds there must have been long periods unbroken by any volcanic eruptions. This is proved by the existence of beds of marine limestone and chert enclosing remains of corals which can not flourish except in waters free from external detritus." Various shallow-water molluscs are also preserved in these beds. Next follows a rather heavy series of fresh-water cherts with thin beds of limestone and marl; the cherts contain a large amount of silicified wood, "both monocotyledons and dicotyledons . . . sometimes . . . a foot in diameter," and "abundant

fresh-water gasteropods." These beds are supposed to have been deposited in ponds near the base of intermittently active volcanoes; they imply that, in spite of earlier subsidence, the temporarily submerged flanks of the island were built up again above sea level by later eruptions.

The cherts are followed by a heavy series of weaker beds and these are covered by deposits of gravels of moderate thickness, including pebbles of volcanic rocks and silicified wood. "The heterogeneity of the deposit would point to its being a beach deposit laid down under the influence of strong currents and tides in an epoch of subsidence between the [preceding] fresh-water lagoon phase and the [following] more open water limestone phase;" and these overlying limestones clearly prove that, in spite of previous upbuilding of volcanic eruptions, the island was eventually submerged by subsidence. Their testimony deserves fuller consideration.

The Overlying Calcareous Rocks

The subsidence, already measuring thousands of feet since the formation of the lowest intercalcated coral-bearing limestone beds in the tuff deposits, must have been long continued, for above the gravels and separated from them by a slight disconformity, comes a great upper series of Oligocene marls and limestones, at least 1,500 feet thick, and very probably thicker still if the uppermost beds which now lie under water off the northeast coast are included. In view of this date for the deposition of the upper strata, the basal volcanic rocks may be of Eocene eruption. According to the report of 1923, the limestones contain "a fossil fauna as noted for its variety as for its abundance. . . . This fauna is essentially a marine one and consists of compound corals, lamellibranchs, foraminifera, calcareous algae, gasteropods and echinoderms. . . . . The commonest lamellibranchs are species of Ostrea and Pecten, the former often reaching a very large size. The algae are chiefly represented by species of Lithothamnion. . . . The compound corals are represented by genera too numerous to mention." The presence of corals within the area of the limestones makes it probable that the outer margin of that area was rimmed by a coral reef, and that the limestones are lagoon deposits. An earlier observer (1919) notes that a fossil coral reef which he found at the disconformable base of the heavy limestone series "grew upon a basement that had been subaerially eroded and was later depressed below sea level;" and that the overlying limestones were "deposited in shoal water on a flattish floor."

There can be no question that a long-continued subsidence was in slow progress while these overlying beds were accumulated, for their fossils are similar throughout; and it is highly probable that, as above implied, the "flattish floor" on which the beds were deposited was that of a shoal-water lagoon enclosed by an upgrowing barrier or atoll reef.

The heavy sedimentary series as well as the underlying volcanic series is here and there entered by dikes, and is in at least one locality interrupted by agglomerates, which are interpreted as having been poured out upon the underlying beds and buried by the overlying beds; but the small volume of these high-level volcanic rocks of late intrusion or eruption is negligible in comparison with the great volume of the sedimentary series. Hence, while the earlier phase of the long-continued subsidence witnessed a more or less frequent production of volcanic agglomerates and ash beds alternating with occasional marine calcareous deposits, the later phase of the subsidence was accomplished, as far as the part of the original mass now seen in the beveled island is concerned, almost without eruptions and was rarely disturbed even by deep-seated intrusions. During this later phase, the original volcanic island seems to have been wholly submerged, for limestones and marls alone were then deposited. Their accumulation was at last interrupted, at least for the southern part of the atoll now represented by the island, by an uptilting which introduced an era of erosion still in progress. As the upper limestones are of Oligocene date, the era of tilting and erosion probably occupied the remainder of Tertiary and later time.

The Tilted-down Part of the Atoll

The non-emerged part of the atoll is to-day represented by an extensive submarine bank, 5 miles wide on the east and 10 miles on the west of the island, and extending over 30 miles to the northeast; on the farther part of this bank a small and low limestone island, probably of Pleistocene deposition and of recent uplift, is found. It is eminently possible that the northeastern part of the atoll was tilted down when the southwestern part was tilted up; and if so, reef upgrowth and lagoon deposition may have continued in the northeast, thus building up the present bank, while the uptilted southwestern area was suffering degradation; but it is also conceivable that, as Fig. 2 suggests, a gentle flexure separated the uptilted southwestern part of the atoll from a little depressed northeastern remainder. With these possibilities, however, we are not especially concerned.

The Embayed Shore-line and the Headland Cliffs

After the era of degradation was well advanced on the uptilted island, a submergence of moderate measure took place, shown by the change from the broken to the dotted sea-level line in Fig. 2, for the present

shore-line is elaborately embayed. This involved a significant diminution in the size of the island, for its probable northeastward extension in a worn-down lowland now makes part of the shallow submarine bank, above mentioned. The embaying submergence is ascribed to actual subsidence of the maturely degraded island—not to the Postglacial ocean rise into valleys eroded on a still-standing island, while the ocean was lowered in the Glacial epochs of the Glacial period—because the valleys that are occupied by the present embayments even in the more resistant volcanic rocks are thought to be too broad to have been eroded during those epochs.

The headlands of the degraded and embayed island are moderately cut back in cliffs, but the recession of the cliffs is so small that their abrasion can not have been in progress for nearly so long a time as that occupied by the subaerial erosion of the widely opened and partly embayed valleys; for it is well assured that unrestricted abrasion of oceanic islands is a rapid process compared to their subaerial degradation. Hence valley erosion must have been begun relatively long ago and must have continued for a relatively long period, while cliff abrasion must have been a late and brief process.

The cliff faces that were cut in resistant rocks plunge below present sea level; and it is therefore believed that these cliffs have been partly submerged. It is also believed, in view of the long period of valley erosion without cliff cutting, followed by a short period with cliff cutting, that the cliffs were cut by low-level abrasion during the temporary depressions of the ocean in the Glacial epochs of the Glacial period, as will be further stated below; and hence that their partial submergence to-day is largely due to Postglacial ocean rise, and not alone to island subsidence. Similar cliffs cut in weak-rock headlands appear to have been recently cut back farther at present sea level, and are therefore not now seen as plunging cliffs. If the plunging, hard-rock cliffs really represent nearly all the work that abrasion could accomplish, while reef growth was inhibited in the Glacial epochs of lowered ocean temperature and level, then it is all the better proved that nearly all the much greater work of eroding the now-embayed valleys took place during a higher stand of the island in Preglacial time, and that their embayment is due to island subsidence of late date.

The discontinuous fringing reefs that to-day skirt the island shores, as well as the alluvial delta plains that extend inland from the present bay heads and the beaches that swing in curves concave seaward between the volcanic headlands of the southwestern coast, are all believed to be chiefly of Postglacial date. Their Interglacial predecessors would have been largely removed by low-level erosion in the Glacial epochs. It is interesting to note that the beaches, although occupying reentrants between headlands of volcanic rocks, are composed largely of calcareous sand, which must therefore have been swept in from the off-shore bank.

Evidence for the Former Existence of an Atoll Reef

Although the uptilted limestones of the supposed atoll include, as already noted, a number of coral reefs of small thickness which may be regarded as having been intermittently formed in the lagoon area, the enclosing atoll reef, which should be of continuous growth and of great thickness, has not been identified. The discovery of such a reef in the strata of an uptilted and beveled-off island would be a very agreeable confirmation of the belief that its limestones were deposited in the lagoon of an ancient atoll; but the position of the tilted limestones with respect to their ancient volcanic foundation and to the present-day circuminsular bank is such as to make even the expectation of such a discovery unreasonable. The margin of the atoll lagoon where an encircling reef should be found would now stand either high in the air along the southwestern side of the island, where it must have long ago been destroyed by erosion as indicated in Fig. 2, or a few miles off shore in the submarine bank east or west of the island, where after degradation and low-level abrasion it must now be submerged out of reach of observation. The strata of the island being lagoon strata, only discontinuous lagoon reefs are preserved in them.

So long as the atoll reef is not directly shown to have existed, it may not be apparent why the limestone area of the island should be interpreted as representing a reef-enclosed lagoon, instead of a rimless bank. Several reasons for the adopted interpretation may be adduced. In the first place, the presence of fossil coral reefs in the tilted limestones shows that temperature and other conditions were fitted for the growth of reef-forming corals during the period of limestone deposition; and this makes the occurrence of an encircling reef plausible at least. In the second place, the small measure of headland cliff-cutting already noted around the island shore in comparison with the large measure of valley erosion over the island surface demonstrates that, after the period of uptilting, the resulting island must, in spite of the discontinuous development of fringing reefs around it to-day, have been well protected by fringing or barrier reefs during most of its long period of erosion; and a similar demonstration of the former long-continued presence of protecting barrier reefs is furnished by other maturely dissected and well-embayed but little cliffed volcanic islands not far

away. Thus the presence of bank-margin reefs during the earlier period in which the now tilted limestones were accumulated, already shown to be possible by the occurrence of bank or lagoon reefs in the limestones, is made reasonable by the inferred presence of protecting bank-margin or barrier reefs during most of the later period in which the tilted limestones were degraded. Reefs appear to have been wholly absent only during the Glacial epochs of lowered sea level, when the headland cliffs were abraded. In the third place, a neighboring island, composed wholly of limestones evenly uplifted to a moderate height, has been ingeniously interpreted (1867) as representing the lagoon deposits of a former atoll, the marginal reef of which has been cut away by the sea since its uplift. Evidently, the inferred occurrence of a former atoll in the neighborhood of the tilted-up and beveled-off island gives support to the belief that it also was an atoll before it was uptilted. But even if the upper calcareous strata accumulated on a rimless submarine bank, the accumulation must have taken place in shallow water upon a slowly subsiding foundation, and not upon a deep and stationary foundation, shoaled by aggradation as postulated in the Rein-Murray theory.

ABSENCE OF AN ENCIRCLING REEF TO-DAY

If the now uptilted limestones were reef-encircled during their deposition, it might be expected that the beveled-off island and its northward continuation in a shallow bank should be encircled by an off-shore barrier reef to-day, even if they were without reefs during the Glacial epochs. So they should be, if they were situated in a warmer part of the ocean; but they happen to lie in the marginal belt of the coral seas, where they and their neighbors are, even in the present Postglacial epoch, bathed in waters that are hardly warm enough for the vigorous upgrowth of bank-margin reefs, although they do permit the formation of discontinuous fringing reefs near the island shores. This is a general aspect of the problem which I have treated elsewhere[1] and will therefore not enter upon here; it involves the conclusion that Postglacial time is not so favorable for reef growth around these islands as Preglacial and Interglacial times were; a conclusion which finds support in various studies of the climate of those time-intervals based upon Glacial and Interglacial deposits in other regions.

THE TILTED-UP AND BEVELED-OFF ATOLL IS ANTIGUA

The island which is here interpreted as a tilted-up and beveled-off atoll has not been named thus far, because I have wished the reader to consider the problem it involved independently of any opinions he may have previously formed about the island itself. Now that the problem has been set forth, the mask of anonymity may be discarded: the island is Antigua in the Lesser Antilles, and the observers above quoted may be identified among others in the list given below by the dates of their published articles.[2] The volcanic base is of early Tertiary eruption; the atoll superstructure is of mid-Tertiary deposition; and the revelation of the atoll structure is due to later Tertiary tilting and erosion. The neighboring island that was interpreted half a century ago as an evenly uplifted and much abraded atoll is Sombrero.[3]

Confirmation of the idea that protection of the Antigua coast by encircling reefs has long been prevalent and that the temporary absence of such reefs occurred only during the Glacial epochs of the Glacial period is given by the Virgin Islands as well as by St. Lucia and several other members of the Lesser Antillean volcanic chain, where the hard-rock headlands between the embayments which enter mature valleys eroded in the same hard rocks are only moderately cut back in plunging cliffs.

The thickness of the volcanic and calcareous strata seen in the beveled surface of Antigua is at least five and probably eight times as great as the depth of the famous boring in Funafuti atoll of the Ellice group in the central Pacific; and the opportunity for the study of atoll understructure is immensely superior on Antigua to that afforded by the small boring-core from Funafuti, the interpretation of which has produced rather more dissension than demonstration; for the successive deposits of Antigua, from the lowest volcanic beds to the highest limestones, are open to examination in many outcrops along the strike of the strata over distances of from 5 to 12 miles. The evidence that they give for long

[1] The marginal belt of the coral seas. *Amer. Journ. Sci.*, vi, 1923, 181-195.

[2] P. T. Cleve. "On the geology of the northeastern West India islands." Handl. Svensk. Vetensk. Akad., ix, 1871.

J. C. Purves, "Esquisse géologique de l'île d'Antigoa." Bull. Mus. roy. hist. nat. Belg., iii, 1884, 273-318.

J. W. Spencer, "On the geological and physical development of Antigua." *Quart. Journ. Geol. Soc.*, lvii, 1901, 490-505.

A. P. Brown, "Notes on the geology of the island of Antigua." Proc. Acad. Nat. Sci. Phila., 1913.

T. W. Vaughan. " . . . An account of the American Tertiary, Pleistocene, and recent coral reefs." U. S. Nat. Museum, Bull. 103, 1919, 189-524.

K. W. Earle. "Report on the geology of Antigua." "Antigua," 1923.

[3] A. A. Julien. "On the geology of the Key of Sombrero." Ann. Lyc. Nat. Hist. New York, viii, 1867, 251-278.

continued and relatively slow subsidence is indisputable.

As far as I have learned, only one earlier observer, Purves, a Belgian geologist, has regarded Antigua as a tilted-up and beveled-off reef-enclosed island, and even he does not appear to have explicitly stated that it reached the atoll stage of development, although he comes so near to describing such a stage that one must suppose he understood it, mentally at least. His most definite statement is as follows:

> La puissance de cette vaste formation calcaire indique qu'elle s'est déposée pendant une longue période d'affaissement du sol qui a suivi l'extinction de l'activité volcanique et pendant laquelle des récifs de coraux très-étendus se sont librement établis autours des bancs formés par les matériaux volcaniques éjectés lors des dernières éruptions. Ces roches, actuellement visibles, ne représentent pas la substance même du récif, car, pendant la formation du dépôt, ce récif devait être situé à une distance considérable de la côte. Ces amas de marnes et de calcaires avec leur masse de débris de coraux détachés mais très-bien conservés, de bois flotté et échoué, de coquilles et d'orbitoides, représentent évidemment le dépôt particulier que l'on voit encore de nos jours se former par l'accumulation entre la barrière de récifs et les côtes d'une île affectée d'un mouvement d'affaissement lent et continu ('84, 307).

In spite of this clear indication of the association of the Antigua limestones with an ancient barrier-reef system and the explicit recognition that the ancient reef is not now visible, the island has not gained the reputation that it deserves as a tilted-up and beveled-off atoll. Several observers of later date than Purves do not make so close an approach to imputing this origin to it as he did.

Antigua has many features of interest, which I enjoyed seeing during a ten-day visit in November, 1923. Its lower lands of fertile calcareous soil have long been cleared and cultivated, sugar cane being the chief crop. English harbor, an embayment on the southern coast between slightly cliffed headlands of submountainous form, back of which rises a well-defined tuff cuesta, was at one time strongly fortified as the chief British naval base in the West Indies; it was there that Nelson refitted his fleet after an engagement with the French in an early year of the nineteenth century. St. Johns, the chief town of the island to-day, was an excellent center for my excursions, which were all the more pleasant from the competent guidance by hospitable officials and residents with whom I made acquaintance. The town lies at the head of an open embayment which enters the northwestern end of the broad medial lowland worn down across the island on the weak beds between the cuestas of the underlying cherts and the overlying limestones; the other end of the medial lowland is entered by Willoughby bay, across which the limestone cuesta on the north affords a delightful view. Many of the physiographic features above described may be reviewed to advantage from the crest of the main chert cuesta which serves as a delightful Belvidere near the center of the island; and not the least interesting consideration that might be broadly enjoyed in the prospect there opened or more closely reviewed during an examination of the inclined tuffs and limestones in their many outcrops would be the contemplation of the island as a tilted-up and beveled-off atoll; but the conscious contemplation of Antigua as of that origin was denied me; for in spite of my ten-day exposure to the contagion of the infectious facts, a four-month period of unconscious incubation elapsed before the explanation of the facts as here presented "broke out" upon me. It then appeared that the deep understructure of the island agrees, as far as it is now revealed, in every essential respect with the understructure that an atoll, formed according to Darwin's theory of slow upgrowth from a slowly subsiding foundation, should possess.

W. M. Davis
Harvard University

THE FISHERIES BIOLOGICAL LABORATORY, WOODS HOLE, IN 1923[1]

When the laboratory was opened on June 20 three investigators of the bureau's regular staff who had been at the station during the greater part of the preceding winter and another who had arrived early in June were already there engaged in investigations which had begun at or through the laboratory in the preceding summer and continued without interruption.

The temporary official staff of the station consisted of the director and one scientific assistant. The laboratory enjoyed the hearty cooperation of Superintendent W. H. Thomas and the general staff of the station under his direction. Invaluable service to the director and to investigators was rendered by Robert A. Goffin, collector, and by the fisheries steam launch, *Phalarope*, with Robert Veeder as master. Helpful service was rendered in the office and library by Allan A. Grafflin, and in art work by Kenneth G. Phillips, under the War Veterans Bureau. In addition to the *Phalarope*, employed for longer trips, two smaller launches and a number of rowboats were available.

In all, there were in the laboratory 28 investigators and assistants, of whom 14 were engaged upon official work and 14 upon independent studies. There fol-

[1] Published by permission of Mr. Henry O'Malley, United States Commissioner of Fish and Fisheries.

lows a list of the investigators and topics of investigation. Results are given in a few instances, selected not with special reference to the merits of the particular researches, but rather with a view to better illustrating the type of investigation and the general interest of the work pursued in the Fisheries Laboratory.

Charles J. Fish, general assistant, of the *Albatross*, who had been attached to the laboratory throughout the preceding year, continued his investigation of the daily and seasonal variation in the plankton of the Woods Hole region. The work until July had consisted of daily observations on physical conditions and plankton collections taken from the end of the Fisheries dock. Beginning with July of the past summer, and employing the *Phalarope*, similar observations have been made at regular intervals throughout Vineyard Sound and Buzzards Bay, with the primary purpose of studying the horizontal distribution of the various planktonic organisms. The unusually cold weather prevailing throughout the previous spring was found to have had a notable effect on the plankton of the region. Almost all the pelagic forms appeared later than usual. The diatom swarm that in 1922 appeared on June 15 arrived in Great Harbor this year on August 9. Some animals that were comparatively common during the preceding summer did not appear at all in the summer of 1923. The effect of the temperature on the breeding seasons of invertebrate animals was distinctly observable in Vineyard Sound, where in the deeper waters temperatures were found in August to compare with temperatures at Woods Hole in Great Harbor in late May and June, and where at the same time the plankton was found to be identical with that of Great Harbor in May and June. All observations indicate that temperature is the dominant factor governing the seasonal distribution of the local plankton fauna. Dr. Fish's data and conclusions will appear in publications of the bureau.

Mrs. Marie D. Fish, field assistant of the Bureau of Fisheries, is engaged in studies of the identification and seasonal distribution of the larval fish of the Woods Hole region, having available material collected daily at Woods Hole and at certain intervals in Buzzards Bay and Vineyard Sound and in the waters of the sea immediately without the sound, as well as collections made at the station in past years by the late Vinal Edwards, by Robert A. Goffin and by others. She has also assisted Dr. Fish in his plankton studies.

Paul S. Galtsoff, naturalist of the *Albatross*, was engaged primarily in examination of data and materials collected in the biological and hydrographic reconnaissance of Long Island Sound that he has been conducting since June, 1922, with the use of the Fisheries Steamer *Fish Hawk*. Salinity determinations (by titration) were made upon 500 samples of water previously taken in the sound, and the volume of the plankton was determined for 275 quantitative samples of plankton. He made a comparative test of the centrifuge method and the filtering method (sand filter) as employed in microplankton examinations, finding that the sand filter method yielded more accurate results. He made also a study of the food of oysters from Wareham River, Buzzards Bay, finding (in June) that it consisted chiefly of bottom-living diatoms. In cooperation with Mrs. Galtsoff, he continued investigations of regeneration of silicious sponges after their dissociation. It was learned that Ca-ions are necessary for the formation of the aggregates of separated cells, that alkaline sea water (pH 9.8) increases adhesiveness of protoplasm and facilitates to a certain extent the formation of aggregates of cells from different species, and that the rebuilding of a new organism from a clump of cells depends on the stereotropic reaction of the cells. The histology of the regenerative process was also studied.

J. Paul Visscher, special assistant of the Bureau of Fisheries in cooperation with the Department of the Navy, was engaged in a study of the fauna and flora of ship's bottoms and the factors affecting attachment of organisms to the bottoms. By expeditions to various ports, on notification of arrivals, he examined 15 vessels in course of the summer, supplementing observations made in a similar manner during the preceding winter and spring. The materials collected were studied at the laboratory, where he also conducted experiments to determine the reactions of fouling organisms to light and to color of substratum. It was determined for certain specific forms that the larvae at the time of attachment are negative to light, and it was also found that steel plates submerged in a tidal current incurred less fouling if painted in lighter colors. He also conducted studies of the life history and distribution of barnacles and determined for three species the resistance when exposed to fresh water and to air.

Professor Charles B. Wilson, of Massachusetts State Normal School, Westfield, Massachusetts, assisted by John E. Wilson, temporary assistant, examined a collection of free-swimming copepods made by Dr. R. P. Cowles in course of the survey of Chesapeake Bay that he conducted with the use of the Fisheries Steamer *Fish Hawk* during the years 1920 and 1921. The collection comprised about 700 hauls made at 35 separate stations at different times of the year, at different hours of the day and night, at different depths, and under different conditions of tide, salinity and temperature of water, as well as with nets of various sizes of mesh. They examined

all the hauls, recorded the different species of copepods found in each, calculated the total numbers of individuals in each haul and the relative number of individuals of each species represented. By incidental examinations of local fishes they secured 25 species of parasitic copepods, including four or five new species and one new genus, which will be more fully described at a later time.

The four major investigations of the bureau, of which account has just been given, were all concerned in some way with the small floating or swimming organisms of the sea and its bays and with the conditions affecting the distribution and abundance of such organisms. The investigations were not cooperative; each was entirely independent of the others; but, whatever the original purpose of each study, the results of all must link together to form a broad contribution or series of related contributions to knowledge, (1) of the geographic, local and seasonal distribution of marine and semi-marine plankton organisms, (2) of the effects of the physical conditions of the sea upon the distribution and abundance of such organisms, and (3) upon the seasons and the success of the breeding of marine animals in general. The usefulness and the interest of such studies are obvious, both to those whose interest lies primarily in the discovery of principles of biology and to those who would be able to interpret and to forecast the relative abundance of food fishes at particular times and places; for in the plankton or floating life in the waters is comprised not only "the pasturage of the sea," but, it may be said, the great nursery for nearly all animals of the ocean and its shores and bottoms.

The director of the laboratory, assisted by James T. Penney, obtained a considerable body of material for study of the natural history of Limnoria, the conditions of breeding, and the structural and physiological differences correlated with differing environmental conditions. This study is in continuation of studies in progress based upon material collected at Beaufort, N. C. It is evident that, correlated with the shorter breeding season at Woods Hole, as compared with Beaufort, N. C., the broods of young are much larger in number of individuals in the colder northern waters. The director also made observations in waters of Cape Cod supplemental to previous studies of hydrogen-ion concentration of natural waters as a factor affecting the distribution of freshwater fishes.

The director of the laboratory acted as leader of a party of thirty naturalists from the Fisheries Laboratory and the Marine Biological Laboratory, which made a zoological reconnaissance of Penikese Island with reference to animal life above the tide line. The materials collected were subsequently assorted and distributed to specialists for study and identification. It is hoped that a report may be completed within a year to be published possibly in conjunction with a report of the botanical survey of the island made a few days earlier. The two surveys were undertaken in observance of the fiftieth anniversary of the founding by Louis Agassiz upon Penikese Island of the first marine biological station in America. The observance, by the surveys and otherwise, was initiated by the Marine Biological Laboratory of Woods Hole.

INVESTIGATIONS BY OCCUPANTS OF TABLES

Dr. F. E. Chidester, of West Virginia University, engaged in study of the literature of fish migration and the possible factors affecting it, including hydrogen-ion concentration. He made experiments to develop methods of determination of small quantities of oxygen and carbon dioxide in the blood of fishes, and spent some time in anatomical studies relating to the brain of the blue shark and to other organs of vertebrates.

Dr. N. A. Cobb, of the U. S. Department of Agriculture, with four assistants, investigated the physiology of nemas, especially that of the alimentary tract, with the use of polarized light and *intra-vitam* staining, and by direct observation of the feeding and other habits of nemas. For this purpose he introduced the application of modified petrographic microscopes with decidedly advantageous results. Marine nemas were employed for his studies, because the general physiology is the same in principle as that of the plant-infesting and the soil-inhabiting forms under investigation by the Department of Agriculture while, in size and transparency, the marine forms are far more favorable to such investigations than are the smaller forms in more direct contact with crops of the land. Furthermore, he finds that at the Woods Hole laboratory the marine forms are far easier to collect in sufficient quantity and variety. Incidentally, the examinations were extended to other phyla—to nearly all the animal phyla, in fact. It is thought that the results of the incidental work, which was much aided by eminent specialists at Woods Hole, may in future be the stimulus for much fundamental physiological investigation inside the cell.

Paul S. Conger, of the United States National Museum, assistant to Dr. Albert Mann, specialist in diatoms for the Carnegie Institution of Washington, spent six weeks at the laboratory making collections of diatoms, chiefly marine, as material necessary to continue the studies that Dr. Mann has been conducting for several years relative to the diatom flora of Woods Hole.

Dr. John C. Hemmeter, of Baltimore, Maryland, studied the comparative histology of the abdominal organs of the selachians obtainable at Woods Hole

with special attention to digestive organs—stomach, pancreas (including islets of Langerhans), and liver —and to their reciprocal relations in hematopoiesis and hemolysis with the spleen. In connection with the histological studies, the osmotic phenomena and histology of the blood itself was investigated. Mrs. Hemmeter aided in histologic work and in preparing drawings from microscopic preparations.

Miss Catherine Indorf, of the University of Missouri, studied with Dr. Cobb the structure and habits of nemas, and the technique of their investigation, with the special view of obtaining a knowledge of the technique to be applied in the investigation of a serious agricultural pest in northern Missouri, *Heterodera radicicola.*

Dr. Edwin Linton, of Augusta, Georgia, continued his systematic studies of the internal parasites of fishes, giving attention not only to the final hosts of the parasites but also to intermediate carriers as well, including invertebrates, fish-eating birds and fishes.

Dr. G. A. MacCallum, of Baltimore, investigated parasites of fishes, chiefly sharks, with special reference to trematodes of the gills and nasal glands. He also collected parasites from turtles and other reptiles, obtaining some new forms, which will be studied and reported upon at a later time.

Thomas F. Morrison, of Princeton University, examined many different forms of marine animals for fluorescence. It was found that the phenomenon of fluorescence is very widespread, but, due to pigmentation present, it is not perceptible in all cases. Clear protoplasm, such as is found in the embryonic tissues, exhibits a light blue fluorescence, while similar tissues from adults exhibits a greater variety of fluorescent colors. Various body fluids were found to be fluorescent, the fluorescence of the decomposition products being especially marked. The chemical nature of these substances was studied, and it was found that practically all groups of biochemical compounds contain fluorescent members. The source of light used in these experiments was a carbon arc and glass filter. The incident light was rich in ultraviolet to 350 μμ but weak beyond 300 μμ. The upper limit was 425 μμ.

During a brief stay at the laboratory, Professor A. M. Reese, of West Virginia University, worked upon the structure and development of the oral glands of certain pit vipers.

L. R. Safir, of Columbia University, continued genetic researches with the use of *Drosophila melanogaster.* His particular problem was to locate more definitely in the third chromosome the loci of some 8 or 10 factors. Crosses involving upward of 30,000 offspring were carried out. He also studied the effect of X-rays on the offspring derived from a Mendelian cross, arriving at the general conclusion from genetic evidence that the X-raying of the flies caused a disturbance in the sex or X chromosomes so that they do not disjoin.

Dr. Henry C. Tracy, of the University of Kansas, studied the development of reactions in teleost embryos and larvae, with particular reference to chemical and physical factors influencing the early movements of teleost larvae.

Professor H. V. Wilson, of the University of North Carolina, with Henry V. Wilson, Jr., was at the laboratory for a few days obtaining material for histological studies of sponges.

R. E. COKER,
Director

UNIVERSITY OF NORTH CAROLINA

SCIENTIFIC EVENTS

THE NATIONAL MUSEUM OF ENGINEERING AND INDUSTRY

ONE million dollars has been assured towards the establishment of the National Museum of Engineering and Industry, Incorporated, with headquarters in the Engineering Societies building. A campaign to raise an additional nine million dollars has been started. The president of the new organization is Dr. Elihu Thomson, who recently received the Kelvin Gold Medal from the Royal Society at the Kelvin centenary in London. The vice-presidents are Dr. Edward G. Acheson, one of the creators of the modern abrasive industry, Dr. Leo H. Baekeland, inventor of velox paper and bakelite and president of the American Chemical Society, and Dr. Edward Weston, creator of the Weston type of electrical instruments. Its trustees are Mr. Philip T. Dodge, chairman of the International Paper Company; Mr. Howard Elliott, chairman of the Northern Pacific Railroad; Dr. Ira N. Hollis, president of the Worcester Polytechnic Institute; Dr. Elmer A. Sperry, president of the Sperry Gyroscope Company, and Mr. Worcester R. Warner, of Warner & Swasey, Cleveland, Ohio, makers of telescopes. Mr. George E. Roberts, vice-president of the National City Bank, is treasurer and Mr. H. F. J. Porter, industrial engineer, is secretary.

In cooperation with the Smithsonian Institution the new organization is planning to erect on its grounds in Washington a building to house the original models of early inventions and the records of constructive achievement of pioneers, inventors and engineers in the development of transportation and industry. In this way the United States will be given the kind of institution which all the great European nations have possessed for years, and in the layout of the proposed museum use will be made of the data collected by an expert who has recently returned from a year's survey of museum practice abroad. An important de-

parture in the American scheme is proposed, however, made necessary by the vastness of the country. In addition to the central collection at Washington special collections such as replicas of the historical exhibits will be carried to the people, also the machinery of modern processes will be placed in affiliated museums in industrial centers of every state.

Incorporation was effected in March last under the laws of the District of Columbia by the "Organizing Committee of 100" composed of chairmen of boards of directors, presidents and chief engineers of industries and railroads, and professors of engineering and history in universities and colleges.

HELMHOLTZ'S PHYSIOLOGICAL OPTICS

It is announced that the first volume of the English translation of Helmholtz's *Handbuch der Physiologischen Optik,* prepared under the editorship of Professor Southall, of Columbia University, and published by the Optical Society of America, is now ready for distribution. The importance of this work as one of the monuments of scientific creation is universally recognized, but this translation is inspired by a realization of its present value to scientific workers and not merely of its historical significance. Although of course many things in it have become antiquated, there are also many that have been overlooked or neglected, and whose value has not been diminished by subsequent research. Moreover, there is no other book, nor even any combination of books, in which anything comparable to it as a conspectus of the whole subject can be found.

In selecting for translation the third (and latest) edition, 1909–10, the editor has in large measure been influenced by the incorporation in that edition of most valuable appendices by v. Kries, Nagel and Gullstrand; and besides these appendices the English translation will include (in the first volume) an entirely new chapter on ophthalmoscopy taken from Professor Gullstrand's *Einführung in die Methoden der Dioptik des Auges des Menschen.* Since, on the other hand, the third edition (based by v. Kries and Nagel on the first) omitted the very important work of König, done in direct development of Helmholtz's ideas and incorporated in the second edition, this phase of the subject is briefly treated in an appendix (to appear in the second volume) by Christine Ladd-Franklin, which will also contain a critical examination of the Helmholtz and Hering theories of color vision and a concise exposition of her own theory. The time of the publication of the second and third volumes is not yet fixed. The edition is limited to one thousand copies. Orders should be placed with F. K. Richtmyer, Cornell University, Ithaca, N. Y.

THE SECTION OF PHYSIOLOGY OF THE BRITISH ASSOCIATION

Oversea members of the British Association for the Advancement of Science coming to the Toronto meeting, beginning August 6, include the following:

President of Section I—H. H. Dale, head of the department of biochemistry and pharmacology, Medical Research Council, London. Former director of the Wellcome Physiological Research Laboratories. His presidential address will deal with "Progress and prospects in chemotherapy."

Vice-president—G. H. F. Nuttall, Quick professor of biology, Cambridge. Editor and founder of the *Journal of Hygiene* and the *Journal of Parasitology.*

Recorder—Dr. C. Lovatt Evans, of the department of physiology, St. Bartholomew's Hospital Medical College, London, will discuss "The physiology of muscular contraction in relation to efficiency and fatigue."

Secretary—E. P. Cathcart, Gardiner professor of chemical physiology, University of Glasgow, and adviser in physiology to the War Office, will deliver a paper on the "Respiratory quotient," and a popular lecture on "Seeing is believing" and will discuss "Energy exchange in relation to muscular performance in laboratory investigations."

J. H. Burn, of the biochemistry department of the Medical Research Council, London, will speak on "The factors controlling the normal output of sugar from the liver."

S. Monckton Copeman, medical officer, Ministry of Health.

J. C. Drummond, of University College, London, will give a popular lecture on the "Importance of the infinitely small in nutrition," and will speak also on "Modern tendencies of vitamine research."

Sir Henry Gauvain, medical superintendent to Lord Mayor Treloar's Cripples' Hospital and College, will discuss light therapy in the symposium on "Vitamines and the relation of light to their action."

E. Mellanby, St. Thomas Hospital, London.

J. S. Owens.

Sir J. Herbert Parsons, surgeon of the Royal London Ophthalmic Hospital, optical surgeon in University College Hospital and a member of various government committees.

H. E. Roaf, professor of physiology, London Hospital Medical College, will give papers on "Color vision" and on "Urinary pigments."

Alfred Herbert Tubby, consulting surgeon, especially on diseases of children.

THE EDWARD HART CELEBRATION AT LAFAYETTE COLLEGE

Dr. Edward Hart has now completed fifty years of service in connection with the chemistry department of Lafayette College and it is proposed to cele-

brate the event on October 16, 17 and 18 by an intersectional meeting participated in by the Lehigh Valley section, the New York section, the Philadelphia section, the Wilmington section and the South Jersey section of the American Chemical Society. This time is chosen because it immediately follows the centennial celebration of the founding of Lafayette College with a pageant on October 15.

On Thursday afternoon the general theme "Fifty years of chemistry in America" will be discussed by Dr. Edgar F. Smith, Dr. Harvey W. Wiley, Dr. William H. Nichols and Dr. Bradley Stoughton. In the evening there will be a dinner in honor of Dr. Hart. Friday will be devoted to a plasticity symposium during the entire day. Our knowledge of plasticity is very defective, but the science of the flow of matter is fundamental to an understanding of colloid chemistry and many industries have plasticity problems which urgently demand solution, so it is hoped that the conference will be of benefit. On Saturday there will be excursions to different points of the Lehigh Valley: (1) Cement and slate industries and the Delaware Water Gap. (2) Chemical and metallurgical industries of Easton and Philipsburg. (3) Lehigh University of the Bethlehem Steel Company. (4) The New Jersey Zinc Co., at Palmerton, Pa.

Correspondence should be addressed to Professor Eugene C. Bingham, Lafayette College, Easton, Pa.

SCIENTIFIC NOTES AND NEWS

IN recognition of his nomination for the presidency of the American Society of Mechanical Engineers, and of his imminent retirement from the position of head of the department of mechanical engineering at Stanford University, Professor William F. Durand was entertained with a dinner in his honor on June 18, under the auspices of the Stanford branch of the American Society of Mechanical Engineers.

DR. ALBERT F. BLAKESLEE, plant geneticist at the Carnegie Station for Experimental Evolution, Cold Spring Harbor, N. Y., has been elected a corresponding member of the Dutch Botanic Society.

PROFESSOR MICHAEL I. PUPIN has received the honorary degree of doctor of science from Princeton University.

DR. FRANK BILLINGS was awarded the honorary degree of LL.D. at the recent convocation at the University of Cincinnati.

THE *Journal* of the American Medical Association reports that as a result of the general election in Japan held on May 10 fifteen medical candidates secured seats in the lower house. These include Dr. Milzinosuke Miyajima, director of the Kitasoto Institute for infectious diseases.

DR. EDWARD MELLANBY, professor of pharmacology at the University of Sheffield, has been awarded the Stewart Prize of the British Medical Association for work on the relation between rickets and dietetic deficiency.

CHARLES M. UPHAM, state highway engineer of North Carolina, has been recently appointed director of the advisory board on highway research of the National Research Council, to succeed Dr. W. K. Hatt, who has resigned in order to resume his work at Purdue University.

DR. C. W. LARSON has been appointed chief of the new bureau of dairying of the Department of Agriculture created under an act of the last session of congress. The work of the bureau was formerly carried on by the dairy division of the bureau of animal industry of which Dr. Larson was chief.

DR. CHARLES N. GOULD has been appointed director of the Oklahoma Geological Survey.

THORNTON T. MUNGER has been appointed director of the Northwest Forest Experiment Station now being organized in the United States Forest Service.

DR. FRANK D. KERN and Professor H. H. Whetzel have sailed for a two-month stay in the West Indies for the purpose of studying the plant rusts of that region.

PROFESSOR WILHELM STEPP, director of the university polyclinic at Giessen, has been given a six months' leave of absence to study vitamins in the United States, on the invitation of the Rockefeller Foundation.

NORMAN TAYLOR, curator at the Brooklyn Botanic Garden, is spending the summer at Montauk, Long Island, studying the effect of wind on the transpiration and growth of plants. A temporary laboratory has been erected on an exposed part of the Montauk Downs, where the wind movement is among the greatest recorded for any part of the Atlantic Coast.

DR. KAZUMI KAWAMURA, professor of soils and agricultural geology at the Imperial University of Tokio, is spending a five-month period of investigational work in the department of soils, University of Wisconsin. He has been appointed to an honorary fellowship and is pursuing his researches under the direction of Professor Truog.

C. P. LATHROP, junior chemist of the Food Control Laboratory, has resigned from the Bureau of Chemistry, to accept a position as technical adviser of the National Preservers and Fruit Products Association, with headquarters in Washington.

DR. H. M. LEAKE, late director of agriculture of the United Provinces, India, and late principal of the Cawnpore Agricultural College, has been appointed

principal of the Imperial College of Tropical Agriculture, Trinidad, to succeed Sir Francis Watts.

DR. HARRY V. HARLAN, of the United States Department of Agriculture, spoke at Kansas State Agricultural College on June 25 on "Agricultural and social conditions in Abyssinia."

DR. F. W. UPSON, chairman of the department of chemistry at the University of Nebraska, will spend the week of November 17 to 22 at the University of Arizona, where he will deliver a series of lectures in the department of chemistry and before the Arizona section of the American Chemical Society.

A MEMORIAL, in the form of an endowment of the department of biology, is to be created at Whitman College for Dr. Robert Clark Yenney, at the time of his death professor of medicine at the University of Oregon Medical School.

SIR F. W. DYSON, the Astronomer Royal, in the presence of a large gathering of British and oversea astronomers, recently unveiled a tablet in the Berkshire County Council school, Wallingford, to commemorate the services to astronomy of the late Mr. T. H. Astbury, headmaster of the school for many years.

BENJAMIN G. LAMME, chief engineer of the Westinghouse Electric and Manufacturing Company, known for his researches and inventions on power problems, died on July 8.

DR. F. W. IVES, professor of engineering at Ohio State University, died on July 5, aged thirty-nine years, from injuries sustained in the wreck of a passenger train.

WILFRED CAMPBELL, one of the leading turbine engineers in the United States, died on July 7, at the age of forty years.

DR. ANDREW R. ROBINSON, formerly professor of dermatology at the New York Polytechnic Hospital, died on July 8, aged seventy-eight years.

DR. CHARLES HUNTER STEWART, professor of public health at the University of Edinburgh, has died in his seventieth year.

THE next meeting of the French Association for the Advancement of Science will be held in Liége from July 28 to August 2.

THE seventy-second annual meeting of the American Pharmaceutical Association will be held in Buffalo, from August 25 to 31, under the presidency of Professor H. V. Arny, of the Columbia University College of Pharmacy.

THE Indian Universities Conference has recommended to the government the appointment of a central advisory board for scientific research.

ORLANDO RANGEL, a pharmacist of Rio de Janeiro, has endowed a fund for a quadrennial prize to be awarded by the Academia de Medicina at Rio de Janeiro for distinguished work in medicine or pharmacy. The prize is to be conferred for the first time on the centennial anniversary of the academy in 1928.

THE collection of tenthredinoidea or sawflies, formed by the late Professor Alexander D. MacGillivray, of the University of Illinois, has been purchased by that institution. It includes some four hundred types and one thousand species.

WITH a record enrollment and new living quarters, the summer session of the Puget Sound biological station of the University of Washington has opened at Friday Harbor for a six-weeks' term. Two laboratory buildings of tile construction and a kitchen and dining hall have been completed in time for the opening of this session. Dr. Theodore C. Frye, of the university, is in charge of the station. He is assisted by Professors Trevor Kincaid and John E. Guberlet, of the university, and three visiting scientists: Professors Harold Kylin, of the University of Lund, Sweden; V. E. Shelford, of the University of Illinois, and E. J. Lund, of the University of Minnesota.

REPRESENTATIVES of the various executive departments and scientific establishments of the government opened a conference at the Navy Department July 1, for the purpose of formulating plans for a naval expedition to undertake investigations in all phases of the science of oceanography. The meeting was opened by Secretary Wilbur and Dr. G. W. Littlehales, hydrographic engineer of the Navy Department, explained the purpose of the projected expedition as serving the varied interests of the navy, commerce and navigation as well as numerous sciences.

A MEETING of the research advisory committee of the American Electroplaters Society was held at the Bureau of Standards in June. The status of the various researches on nickel deposition was discussed and suggestions were received for further work in this field. Special emphasis was laid upon the desirability of bringing the manufacturers themselves into closer contact with the results of research, and it was suggested that at some future conference the manufacturers be invited to send their managers or superintendents.

THE United States Civil Service Commission announces an examination for assistant entomologists, applications closing on August 12. The examination is to fill vacancies in the Bureau of Entomology, Department of Agriculture, at an entrance salary of

$2,400 a year. The duties of the position are to conduct experiments with insecticides in the control of the Japanese beetle grubs, and in the utilization of bacterial and fungus diseases against the Japanese beetle.

FIVE-YEAR courses in engineering and science will be instituted at California Institute of Technology, Pasadena, beginning next fall. The longer courses have been planned in order that students may be given a more thorough training. For classes entering next fall and thereafter, the present courses will be replaced by two four-year courses, one in engineering and one in physical science. Completion of either course will bring the degree of bachelor of science. These courses will be supplemented by fifth-year programs in civil, electrical, mechanical or chemical engineering, chemistry, physics, geology and mathematics, for the completion of which the degree of master of science will be awarded.

ACCORDING to the *Journal of Terrestrial Magnetism* a new magnetic observatory to replace Greenwich is under construction in the uplands of Surrey at Abinger on a site of 10 acres some 20 miles from London; the work is being financed by the Southeastern and Catham Railway, the electrification of which (the railway is within one half mile of the old observatory) made necessary the discontinuance of the work at Greenwich. The new station is in latitude 51° 11′ 03″ north and in longitude 0° 23′ 12″ west at an elevation above sea of 800 feet, the nearest approach of the railway line being 2¾ miles. The buildings include variation observatory, absolute observatory, residence, caretaker's quarters, offices and dynamo and accumulator rooms. Absolute observations at Abinger were begun March 24, 1924, simultaneous with those at Greenwich and will be continued until the electrification of the railway makes it impossible to observe at Greenwich; it is expected that the observations may be continued until the end of 1925.

WITH the additional appropriations that became available July 1, it will be possible for the Department of Commerce to expand several of its activities, one of which is its work on the non-ferrous metals. While considerable work has been done on these metals, that activity has not been accentuated as much as will be the case from now on. The section is to be reorganized as a division, and will be known as the Minerals Division, since work will be done on other minerals. The work will be under the immediate direction of James A. Stader, who has been chief of the minerals section of the iron and steel division.

WE learn from *Nature* that the council of the senate of the University of Cambridge has issued a report on the Jacksonian professorship of natural philosophy, which has been suspended since the death of Sir James Dewar. The professorship is only partly endowed and funds are not available to complete the stipend up to the normal scale. The council, in the hope of attracting a succession of distinguished men of science from outside Cambridge, proposes that the professor shall not necessarily be required to reside and that he should be appointed for one year, the same person not to be eligible for more than two years in succession. This proposal, if adopted, would involve the creation of a new class of professorships in the university not subject to the ordinary regulations governing the regular teaching professors.

AN investigation of safety conditions in the oil fields of the country is being made by the Department of the Interior, through the Bureau of Mines. Information will be obtained from the properties visited regarding safety experience and methods and devices used for increasing safety. It is planned to take photographs to illustrate safety articles and bulletins showing safe and unsafe practices; gather and publish accident statistics, and disseminate among operators, foremen and workmen, by personal visits and orally, with more concrete application than written communications would probably provide, the arguments for increased safety in the oil industry.

THE new educational unit recently established at the University of Chicago under the name of the Institute of Meat Packing, of which Professor Emery T. Filbey, dean of University College, has been appointed director, is under the general control of a joint administrative committee consisting of seven representatives of the university and four of the Institute of American Meat Packers. The members representing the University of Chicago include James Hayden Tufts, dean of the faculties and vice-president of the university; Leon Carroll Marshall, chairman of the department of political economy; William H. Spencer, dean of the School of Commerce and Administration; Emery T. Filbey, dean of University College; Hervey F. Mallory, secretary of the Correspondence-Study department; Julius Stieglitz, chairman of the department of chemistry, and Charles C. Colby, associate professor of geography. The members of the Administrative Committee representing the Institute of American Meat Packers include Thomas E. Wilson, chairman of the Institute Plan Commission; Oscar G. Mayer, chairman of the committee on educational plans, institute plan commission; William Whitfield Woods, vice-president in charge of the department of education and research, and Willard Eugene Hotchkiss, director of the bureau of industrial education.

In order to popularize the metric system, the introduction of which into Russia was provided for by a decree of the Council of Commissaries in 1918, an order has been issued making mandatory the sale of fresh milk in ¼, ½ and 1 liter containers, commencing January 1, 1924, and the sale of products widely used by the population in standard packages, in metric units, is now being organized according to *Economic Life,* Moscow. The decree for the introduction of the metric system was to have become effective January 1, 1922, but the date was subsequently deferred with the understanding that the transition to metric weights and measures by all state institutions and private organizations and persons should be carried out gradually and completed by January 1, 1927. Certain industries (textile, leather, sugar, tobacco, starch and glucose, oil-crushing, tea and coffee, chemical, confectionery, canning and yeast) adopted the metric system by January 1, 1924; the leather goods trade by June 1, and the electrical industry will adopt it by November. Metric units should be used in all technical plans and specifications, commencing October 1, 1925, and in all credit and banking accounting, as well as in budgetary specifications, after October 1, 1926. The number of scales and balances of various types now in use in the entire territory of the Soviet Union is estimated at 1,500,000, including 70 per cent. of even scales, which do not require any adjustment for metric weights; 20 per cent. of decimal beam scales; 8 per cent. of centimal lever scales, and 2 per cent. of miscellaneous devices. Thus only about 450,000 balances will have to be remodeled for the metric system. The total cost of the introduction of the metric system, including the casting of 30,000 tons of weights, popularization and instruction, is estimated at 11,200,000 gold rubles.

UNIVERSITY AND EDUCATIONAL NOTES

The University of Wisconsin will receive $350,000 by the bequest of Thomas E. Brittingham.

Ground was broken on June 17 for the State University of Iowa's new $4,500,000 medical building, made possible by the state appropriating funds to equal a gift of the Rockefeller Foundation.

Professor E. C. Coker, head of the department of mathematics of Winthrop College, has been called to the chair of astronomy and mathematics at the University of South Carolina.

Miss Lila Sands, Ph.D. (Nebraska, '24), has been appointed an instructor in the department of chemistry at the University of Arizona.

Dr. Richard Hartshorne, Ph.D. (Chicago, '24), has been appointed instructor in geography at the University of Minnesota.

Cyril Batho, D.Sc., associate professor of applied mechanics and hydraulics at McGill University, has been appointed professor of civil engineering at Birmingham University in place of Professor F. C. Lea, D.Sc., who has resigned.

Professor Sydney Chapman, professor of mathematics and natural philosophy in the University of Manchester, has accepted the invitation of the governing body of the Imperial College of Science and Technology to undertake the chief professorship of mathematics, beginning in September, in succession to Professor A. N. Whitehead, who has been appointed to the chair of philosophy at Harvard University.

DISCUSSION AND CORRESPONDENCE

CORROSION OF POLISHED METAL SURFACES BY ULTRA VIOLET RADIATION

In previous investigations of the reflecting power of metals no mention is made of the corrosion of polished surfaces by the action of ultra violet radiation which seems to accelerate atmospheric corrosion.

In the course of an investigation of the ultra violet reflecting power of metals and of sulphides having a high metallic lustre Mr. C. W. Hughes and I have observed that portions of the surface which are exposed to ultra violet light become tarnished, while the unexposed parts remain bright. This corrosion is best perceived by breathing lightly upon the surface. Its effect is to perceptibly lower the reflecting power in the spectral region of wave lengths less than 350 μ.

W. W. Coblentz
Lowell Observatory

A QUESTION OF CLASSIFICATION

In view of the extremely up-to-date attitude of the geneticists, cytologists and taxonomists, whose conclusions are changing almost from day to day, it is extraordinary to note how excessively conservative they seem to be when dealing with the larger questions of plant classification. In many current textbooks the same primary divisions, or sub-kingdoms, are accepted that were in vogue more than half a century ago. One is inclined to ask whether this is the result of ignorance or merely of indifference.

While it is true that a separation of the plant kingdom into properly coordinated primary divisions is by no means a simple matter, it is rather depressing to find, even in the latest texts,[1] excellent in many respects, no effort at the presentation of a classification more in keeping with our present knowledge of plant relationships. To find that great omnium gatherum of unrelated plant-groups, the

[1] For example, Sinnott's "Botany, Principles and Problems," recently reviewed in Science.

thallophytes, accepted as a single primary division or sub-kingdom, while the undoubtedly homogeneous group of embryophytes—the Archegoniates and seed-plants—is split into three sub-kingdoms, each presumably coordinate with the whole aggregation of thallophytes, makes one wonder by what process of reasoning the authors have perpetuated such an unscientific and outgrown system of classification.

It is generally agreed that comparative morphology, and especially the structure of the reproductive parts, is the safest clue to relationships upon which a scientific classification must rest. In the book referred to[2] the following passage occurs: "This group (Anthocerotales) has always been of particular interest. . . . as suggesting a possible connection between bryophytes and those higher plants (pteridophytes) in which the sporophyte is an independent individual." But a few pages further on (p. 325), the astonishing statement is made, "In passing from the bryophytes to the pteridophytes . . . we cross the widest gap which exists in the continuity of the plant-kingdom!"

How is the student to reconcile such an obvious contradiction, and how is the instructor to justify a system which teaches that a bacterium and a giant kelp are more closely related than a liverwort and a fern, although the two latter agree in the minute details of the essential structures of both their sexual and non-sexual reproduction? Either comparative morphology has no meaning, or the divorce of the two divisions of the archegoniates is absolutely unwarranted.

It would be very gratifying if some of the defenders of this, to the writer quite incomprehensible, view would explain *in detail* the reasons for the faith that is in them.

STANFORD UNIVERSITY

DOUGLAS HOUGHTON CAMPBELL

CATALOGUE OF PUBLISHED BIBLIOGRAPHIES IN GEOLOGY 1896–1920[1]

THE publication of this noteworthy catalogue of bibliographies as No. 36 of the bulletins of the National Research Council is a further extension of the Council's efforts to supply bibliographic assistance to the research workers of the country. Previous bulletins have contained similar lists covering periodical bibliographies and abstracts, and the present issue is the first devoted to a single subject. Like the earlier publication the present volume is not a bibliography of geology, but simply a catalogue of published geological bibliographies. The project was undertaken for the Research Information Service and the Division of Geology and Geography, National Research Council, and it is hoped that the council is planning to issue similar catalogues for the other sciences.

The catalogue which Professor Mathews has prepared is practically a continuation of DeMargerie's classic *Catalogue des Bibliographies Géologiques*, issued under the auspices of the International Geological Congress in 1896, containing references to 1895. The present work covers the succeeding 25 year period and embraces 3,699 titles arranged alphabetically by subject. These are divided into three groups or categories, general, special and personal. The first group is made up of a list which deals with publications of interest to geologists, but no attempt has been made to include such works as "Révue Bibliographique Universelle," "Reader's Guide to Periodical Literature," and other bibliographical aids, well known to the librarians and bibliographers. In the second group, only one master entry with cross references has been made, and its choice has been determined by the major interest underlying the compilation of the bibliography. The motive has been to place the major entry where it would most probably be sought, and the cross references where they might be serviceable. The third group includes "Personal Bibliographies" and "Necrologies," with attached bibliographies of geologists, mineralogists and paleontologists. The format of the references, while lacking many details dear to the librarian, contains all that is essential to lead the research worker to the available material.

Although the catalogue may prove incomplete as an exhaustive list of foreign bibliographies, it seems to include practically everything dealing with American geological literature available to American geologists. It should save both time and possible oversight of existing information for those in geological research. The National Research Council is to be commended for undertaking the program of preparing such helps for the research worker and also the compiler with his collaborator, Miss Grace E. Reed, for the thorough manner in which they have covered the literature scattered through a thousand serials.

JAMES H. HANCE

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THE NET ENERGY CONCEPTION

IN SCIENCE for April 18, 1924, Dr. E. B. Forbes quotes a paper read by him at a recent meeting of the American Society of Animal Production and a resolution passed unanimously by that society. The present writer dissents from a good deal that is con-

[2] Page 319.

[1] Compiled by Edward B. Mathews, National Research Council, Washington, 1923, 228 pages. Price, $2.50.

tained both in Dr. Forbes's paper and in the resolution; and, as it is a question of deciding on a system of units to be used in measuring the nutritive energy of farm feeds and of obtaining cooperation and support for a certain program of work for the Pennsylvania Institute of Animal Nutrition, he feels that some further discussion is justified.

The following statements seem to the writer particularly questionable:

(From Dr. Forbes's article)

The net-energy conception of Armsby is the simplest and most inclusive of all general measures of nutritive value. . . .

But net energy is the best possible standard for the expression of the most extensive nutritive requirement, and is, in this sense, the best possible single measure of food value generally.

(From the resolution)

These investigations (of Dr. Armsby) . . . have furnished the most accurate quantitative measure of the productive value of different feeding stuffs. . . .

The society endorses the Armsby conception of net-energy values derived from his researches with the respiration calorimeter.

The subject of the energy values of foods is a complicated one. Further articles on it from this laboratory have already been prepared for publication, and further experimental work has already been started. But certain important aspects of the situation may be briefly outlined here.

In Armsby's calorimetric experiments the quantities of heat given out by an animal are compared in two different periods, in which it receives different amounts of a given food. The extra heat given out in the period in which the larger amount of food is consumed is taken as the energy expended in the consumption of the extra food given in that period, and the net energy of the food in question is found by subtracting the energy expended in its consumption as above determined from its total metabolizable energy.

A study of Armsby's work makes it quite clear that a considerable part of the "energy expended in food consumption" in his experiments is expended through increased muscular activity of the animals during the periods in which they receive the larger amounts of food. All energy lost through muscular activity, therefore, is counted as waste in Armsby's system; and it is clear that the net-energy values are not a general measure of the nutritive energy of foods, but at best a measure of the nutritive energy for the special purposes of maintenance and fattening. Other physiological considerations make it questionable whether the net-energy values can be accepted as a measure of the relative values of different foods under practical conditions even for the purposes of maintenance and fattening.

The muscular activity of animals is under the control of the central nervous system, and it is doubtful, therefore, whether its extent under different conditions will be subject to any simple mathematical law. In Armsby's experiments muscular activity is a considerable factor in the energy expended in the consumption of the feeds used by him. If his figures for net energy are to hold good under practical conditions, therefore, it must be assumed not only that the muscular activity stimulated by a given food will be proportional to the quantity of food given, but also that the relative amounts of muscular activity stimulated by different foods under practical conditions will be the same as under the very unusual conditions which obtain in the calorimetric experiments. To the writer both of these assumptions seem highly improbable; and he feels that for this and other reasons it is still far from settled whether figures obtained in such calorimetric experiments as those of Armsby will be of value in comparing different foods for practical use. These experiments have been carried on for about twenty years now, and an extensive table of net-energy values has been published. It is desirable that at this point in the progress of the science of nutrition the net-energy values already in existence should be thoroughly tested out in long-continued practical experiments to determine whether they are a better index of the values of foods for the maintenance and fattening of cattle than are the total digestible nutrients which have been used in the past.

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SCIENTIFIC BOOKS

The Cactaceae, Descriptions and Illustrations of Plants of the Cactus Family. By N. L. BRITTON and J. N. ROSE. The Carnegie Institution of Washington. Vol. I, 1919; Vol. II, 1920; Vol. III, 1922; Vol. IV, 1924.

THE Cactaceae, an exclusively American family of plants of wide geographical range and of varied economic importance, has long needed a thorough revision. Several attempts had been made before, chiefly in Europe, where these plants always were favorites and where quite a special literature treats of their cultivation.

We are therefore much indebted to the Carnegie Institution of Washington for having taken up this matter, at the recommendation of Dr. D. T. MacDougal, in 1912, and to the authors, Drs. Britton and Rose, for their comprehensive monograph.

The authors began their work about 20 years ago. They carefully examined the previous literature, went to Europe to look up the types preserved in the great herbaria or still in cultivation in the collections of public and private botanic gardens, and besides visited and collected cacti in almost every country in the Americas. Thus the authors brought together a most complete collection of herbarium specimens, photographs and drawings as a basis for their work. These large and unique collections are preserved at the Smithsonian Institution in Washington and at the New York Botanical Garden, to which institutions every future student will have to turn. The amount of work involved in this study can hardly be overestimated, but to every student of this family the difficulties which were to be overcome are at least partly known.

The whole monograph consists of four large quarto volumes, beautifully printed and freely illustrated with drawings and photographs in the text and with excellent plates, most of them from colored drawings of Miss Mary E. Eaton, the able artist of the New York Botanical Garden. These plates, besides being most useful to the student, add a great deal of charm to the books and give to the uninitiated at a glance an idea of the wealth of forms and colors of the cactus family.

The whole work describes 1,235 species under 124 genera. Most of these genera have been revived or are newly proposed by the authors. I see in these many newly created genera, the greatest progress made in our knowledge of these plants. They all form well circumscribed and natural groups and convey to us a precise picture of the development or the evolution of these strange plants, which was completely obscured under the old 20 to 24 collective and arbitrary genera of the older monographs.

In looking through these four volumes we are gratified to see the painstaking care of the authors to do justice to their fellow-workers and the enormous amount of new facts and data, which will make this the standard reference work for generations to come. A complete index of the four volumes, carefully compiled by Miss Rebecca Rose, adds to the value of the work for its ready use.

It is to be hoped that the efforts of both the Carnegie Institution and the authors will find ample reward in the increased interest of botanists as well as of the general public in this marvellous entirely American family of plants. The work is purely systematic, but it suggests on every page any number of biological problems which are still to be solved and which will prove the cacti to be one of the most promising fields for investigation.

It is impossible here to enter into detail, tempting as it may be. We must leave that to the reader himself. The authors deserve great credit for their work and the Carnegie Institution is to be congratulated on having presented such an elegant series of volumes to the students and lovers of plants.

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LABORATORY APPARATUS AND METHODS

A SHORTER CELLOIDIN METHOD

THE celloidin method of embedding has never enjoyed the popularity of the paraffin method among botanists, and some laboratories have now abandoned it or employ it only when the desired results can not be obtained by other means. This antagonistic attitude has undoubtedly arisen because of the length of the process, the need of a long series of celloidin solutions, and the application of heat, which is detrimental to delicate tissues, for long periods of time. These objections have been surmounted in a shortened process now employed in this laboratory wherein air pressure is used and only two celloidin solutions are needed.

The pressure tank, which can be manufactured by a millwright for a nominal sum, is made from a piece of iron pipe six inches in diameter and one foot in length with the lower end closed by a cap and the upper bearing a flange two inches wide and about one inch in thickness. A cast iron cover, the diameter of which equals that of the flange, is fitted with an automobile tire valve to permit the introduction and release of air. This cover is ground smooth on the lower surface and by means of eight bolts can be drawn tightly down on to a rubber gasket laid over the flange. Approximately 30 two-ounce bottles can be placed in a tank of this size, providing pieces of wire gauze are inserted between the layers.

The material to be embedded is covered with two per cent. celloidin in uncorked bottles, placed in the tank, and subjected to an air pressure of approximately 100 pounds per square inch for 30 minutes. Slightly lower pressures have been used with good results, but it has been impossible to obtain much higher pressures with a hand-operated tire pump. After the half-hour interval the pressure is slowly released through the valve, the material transferred to 16 per cent. celloidin and the process repeated. A few shreds of celloidin will then serve to thicken the matrix at room temperature, and hardening in chloroform may take place the following day.

To date this method has been used on only two types of material. Dormant buds of trees and woody plants showed an imperfect penetration, nevertheless the infiltration was much better than that obtained by the older method. Cambial material of woody plants, together with the adjacent phloem and xylem, showed excellent penetration with no distortion of the delicate tissues, and cuttings taken in both the resting

and active seasons gave equally acceptable results.

In presenting this note it is the hope of the author that other workers will find it adaptable to their needs.

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SPECIAL ARTICLES

ON THE SIMULTANEOUS DIURNAL VARIATION OF THE ELECTRIC POTENTIAL OF THE EARTH AND THE AIR

IT has been known for more than a century that there is both an annual and a diurnal variation of the electric potential gradient of the air, but there is, as yet, no consensus of opinion among physicists as to the cause of these variations or even of the potential gradient itself.

The fundamental fact is that the earth is surrounded by an electrostatic field, so that if an elongated, insulated conductor be placed vertical anywhere over the surface of the earth it will regularly be found to have a negative charge at its upper end and a positive charge at its lower end. Such a condition can be maintained in a conductor only by the induction of a charge upon some other body. That this condition is maintained in the conductor mentioned above by a negative charge upon the earth or by a positive charge above the earth was plainly shown by Erman, in 1803, and by Peltier, in 1836. Peltier devised an apparatus for determining the potential gradient over the earth which was based upon the laws of electrostatic induction. This potential gradient has come to be called the potential gradient of the atmosphere, since it is measured in the atmosphere and was originally believed to be due to positive electric charges in the atmosphere.

Both Erman and Peltier believed the inducing charge to be upon the earth, and this opinion has been held by many physicists since that time; but others have believed it to be due to positive electric charges in the air or to a positively charged conducting layer in the upper air.

That the latter assumption can not be the true explanation follows from the fact that there is no potential gradient inside a charged hollow conductor due to a charge upon this conductor. Neither can a potential gradient be induced inside a hollow conductor by a charge outside the conductor. It accordingly follows that if the earth is surrounded by a good conducting layer in the upper atmosphere, the only possible potential gradient around the earth must result from its own charge or a charge upon its lower atmosphere.

In SCIENCE of May 25, 1923, the present writer undertook to show that the yearly variation in atmospheric potential gradient is such as would be expected to result upon a negatively electrified earth under the inductive influence of a similarly electrified sun. This paper is intended to show that the same may be said of the diurnal variation.

The writer has shown in various papers[1] that the day side of the earth is regularly electropositive to the night side. It is well known that the atmospheric potential gradient is regularly greater upon the night side of the earth than upon the day side, as it would be if it were due to the induction of the earth's negative charge.

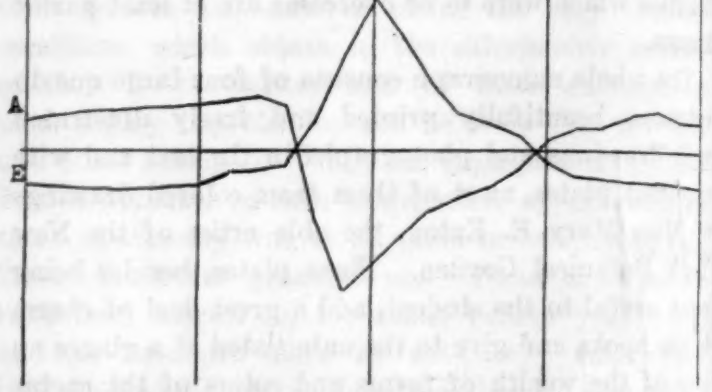

FIG. 1. Diurnal variation of earth potential and of air potential gradient for the months September, 1923–January, 1924. Curve A represents the variation of the air potential gradient and curve E the variation of earth potential.

Since last September, continuous photographic records have been kept of the diurnal changes in both the electrical potential of the earth and of the air. On February 1, the electrometer which was used for measuring the atmospheric potential gradient was moved and its sensitivity was changed, so the present report covers the time from September 1 to February 1. During that time there were occasions when the atmospheric potential gradient was greatly disturbed by storms, and otherwise, but measurable records were obtained for 87 days. All these were used in determining the mean diurnal variation for the period. During the same time 135 measurable records of the earth potential variation were obtained.

The mean values of the two diurnal variations in scale readings are shown in figure 1. Curve E represents the mean diurnal variation of the earth potential and Curve A the mean diurnal variation of the atmospheric potential gradient.

The agreement of these curves with theory is certainly very satisfactory. Since February the two electrometers used in the investigation have been

[1] See, especially, Bulletin of the Terrestrial Electric Observatory of Fernando Sanford, Palo Alto, California, Vol. 1.

placed in the same cage and their deflections are recorded upon the same sheet, and the agreement is, if possible, better than before.

FERNANDO SANFORD

PALO ALTO, CALIFORNIA

THE AMERICAN CHEMICAL SOCIETY

DIVISION OF BIOLOGICAL CHEMISTRY

W. T. Bovie, *chairman*
R. A. Dutcher, *secretary*

Studies of the vitamin potency of cod liver oils—X. Vitamin potency of medicinal cod liver oils: ARTHUR D. HOLMES. In order to obtain information concerning the vitamin potency of present-day medicinal cod liver oils, a number of bottles of oil were purchased on the open market. The chemical and physical characteristics of these oils were determined by the usual analytical methods. A study of their vitamin potency showed that the vitamin content of medicinal cod liver oils may vary as much as tenfold. Also, it appears that there is little, if any, relationship between the chemical and physical characteristics of cod liver oils and their vitamin potency. These results show the need of information concerning the amount of the fat-soluble vitamins present in cod liver oil to be used in vitamin therapy.

Studies of the vitamin potency of cod liver oils—XI. The vitamin potency of butter oils produced on summer feeds. ARTHUR D. HOLMES. To obtain information concerning the vitamin potency of dairy butter, a supply of milk was obtained from several cows. These cows represented a number of well-known dairy breeds, but they were of different ages, and their pasture diet had been supplemented by different commercial grain rations. For the purpose of this study, the milk fat was separated in the form of butter oil. The vitamin potency of the different butter oils was determined under uniform laboratory conditions. The results of these tests indicate that summer butter produced under favorable conditions may have a vitamin potency equal to one hundredth that of first quality cod liver oils.

Detoxication of aromatic cyanides: C. P. SHERWIN and L. R. CERECEDO. Giacosa fed benzyl cyanide to dogs and found an increase in the ethereal sulfate excretion and also a positive reaction with Millon's reagent. He claims to have isolated phenaceturic acid from the urine. We fed benzyl cyanide to dogs and found neither phenaceturic nor hippuric, but free benzoic acid in the urine. After feeding p-chlorbenzyl cyanide to dogs, we noticed no symptoms indicating marked toxicity. We found only p-chlor-benzoic but neither p-chlor-phenaceturic or hippuric acid. We are studying the effects of this compound in the metabolism of the dog.

A method for the estimation of hydrogen sulfide in food products: L. H. ALMY. Hydrogen sulfide is driven out by a current of carbon dioxide bubbling through the aqueous acidified mixture of the food product. It is absorbed in dilute zinc acetate solution, the latter solution then being treated with p-amino-dimethylaniline hydrochloride, hydrochloric acid and ferric chloride solution for the production of the methylene blue color. The amount of sulfide sulfur present is determined by comparison of the color with that of standards prepared by treatment of solutions containing known amounts of sulfide sulfur with the aforementioned test reagents. Analyses of beef, pork and fish showed that hydrogen sulfide was formed progressively during the putrefaction of these products. The method is also applicable to the examination of mineral waters, sewage, bacterial cultures, etc.

The isolation of a crystalline substance (M. P. 223° C.) from autolysed yeast with the properties of a bios: WALTER H. EDDY, RALPH W. KERR and R. R. WILLIAMS. A crystalline substance with a melting point of 223° C. will be exhibited, which by crystallographic methods has been shown to be a single substance and which when added to Fulmer's Medium F. in quantity not exceeding .005 mgs per cc of culture medium increases the volume of yeast cells in a 24-hour incubation at 31° C. by approximately 15 to 20 times that of a control on the medium alone. The method of obtaining this crystalline bios through use of differential adsorbents and pH control will be outlined.

A colorimetric method for the determination of furfural: GUY E. YOUNGBURG and GEORGE W. PUCHER.

The vitamin A content of fresh eggs: JOSEPH C. MURPHY and D. BREESE JONES. Experiments indicate that rats which have been permitted to develop xerophthalmia on a Vitamin A free basal diet can be cured of xerophthalmia, and restored to normal weight by feeding 0.75 gm of fresh whole egg daily. Smaller amounts are sufficient for curing xerophthalmia than for restoring of growth. 0.25 gm fed daily, after onset of xerophthalmia, sufficed to cure the eye condition, without, however, permitting restoration to normal weight and growth. Based on analyses previously reported, 0.75 gm and 0.25 gm of whole egg are equivalent, respectively, to about 0.25 gm and .088 gm of yolk. On the basis of dried yolk, these figures would be 0.13 and 0.41 gm. Expressed in terms of the oil content of egg yolk, about 75 mgm of egg oil would be required for growth restoration, and 25 mgm for curing xerophthalmia.

Determination of the protopectin in Irish potatoes: C. M. CONRAD. In attempting to work out a reliable method for the determination of protopectin in potatoes, the concentration of acid, the pressure and the period of heating have been systematically varied and the resulting pectin determined by the calcium pectate method of Carre and Haynes. The results show that each of these factors has a very important effect. The highest yield of calcium pectate was obtained by boiling the material at atmospheric pressure for one hour in one thirtieth to one fiftieth normal hydrochloric acid. When the other conditions were optimum, a higher pressure did not increase the amount of pectin liberated.

The equilibrium between creatine and creatinine in aqueous solution and the effects of hydrogen ion: GRAHAM EDGAR and H. E. SHIVER. The equilibrium con-

stant for the conversion of creatine to creatinine in aqueous solution has been determined at 25°, 50°, 70° and 100° C. The heat of reaction is about 4,800 cal. The effect of increasing hydrogen ion concentration is to increase the ratio of creatinine to creatine because of the formation of a larger proportion of creatinine ion than of creatine ion. Measurements have been made of the equilibrium conditions in solutions of known pH, and the theoretical relations have been discussed.

The buffer mechanism for the calcion concentration: I. Newton Kugelmass. The calcion concentration is regulated by calcion buffers. They are electrolytes which resist the change in calcion concentration upon addition of calcium salts. Calcion buffers are mixtures of weak acids, HA, and their salts, BA, which react to form normal calcium salts and soluble intermediate calcium salts. The calcion concentration of any calcion buffering solution is given by

$$Ca^{++} = K \div \frac{[HA]^n}{[BA]^{2n}}$$

where r is the ratio of the valence of calcium to that of the acid, and K is an equilibrium constant. Expressed in logarithmic units,

$$\log \frac{1}{[Ca^{++}]} = pK\ pCa$$

and

$$pCa = pK + n \log \frac{[BA]^2}{[HA]}$$

The determination of calcion buffer values: I. Newton Kugelmass.

The estimation of hydrogen ion concentration by colorimetric titration: J. C. Blake. Neutral water, to which has been added the same concentration of neutral indicator as added to unknown, is titrated with dilute (0.01 normal?) acid or alkali until colors match to the eye. Final adjustment is made by further titration in colorimeter vessels, or by motion of plungers. By increasing volume of neutral water started with, any degree of accuracy can be obtained. Colored solutions (for example, urine) yield satisfactory results, provided the color of entire column of liquid is first matched against Lovibond glass slides, which are likewise used in the final titration. The slides also permit establishment of the neutral point for various indicators in terms of unchanging colors.

A factor influencing reproduction and nursing of the young in the albino rat: Chas. H. Hunt. Rats reared on a synthetic diet of purified protein, fat, carbohydrates, salt mixture and vitamins A and B grew at normal rate but were sterile. With this diet and 10 cc milk they were sterile. With this diet minus the salt mixture and 10 cc milk, they were fertile and reared young. With $CaCl_2$ and Na_2HPO_4 added (separately) to the milk, they reared four generations. If the $CaCl_2$ and Na_2HPO_4 were mixed and added to the diet, instead of to the milk, the rats were fertile, but not very successful in rearing young.

Notes concerning the effects of radiation on solutions of albumen: W. T. Bovie and O. C. Woolpert. One volume of egg white was diluted with nine volumes of either distilled water or physiological salt solution and exposed to the radiations of a powerful mercury vapor arc. Before radiation the solutions were adjusted to various hydrogen ion concentrations by the addition of dilute acetic acid or sodium hydroxide and the effect of the hydrogen ion concentration on the heat coagulability of the radiated solutions determined. The hydrogen ion zone of heat coagulation is greatly constricted by radiation. The constriction proceeds, it seems, only from the alkaline side. These results are not in agreement with results previously reported by other investigators.

On the mechanism of the light action on solutions of albumen: W. T. Bovie and O. C. Woolpert. Egg white solutions made up as above with hydrogen ion concentration adjusted for optimum heat coagulation were exposed to a powerful mercury vapor arc at 15°. Coagulum appeared immediately and increased during an exposure of fifteen hours when all the albumen was precipitated. Ten cc portions of a solution of albumen that had been radiated for two hours were removed and heated for half hour periods at temperatures ranging from 25° to 75° C. Each increment of temperature resulted in an increment in the amount of coagulum. Therefore, a radiated albumen solution contains not only molecules which will coagulate at 15° but other molecules which require higher temperatures to produce coagulation.

A micro method for total nitrogen: A. R. Rose.

The inhibition of coagulation in albumen solutions produced by radiation: W. T. Bovie and O. C. Woolpert. Solutions of egg albumen with the hydrogen ion concentration adjusted to the alkaline side of the iso-electric point (5×10^{-7}) at which they may be completely coagulated by heat if radiated for a sufficient period of time do not coagulate upon heating to 100° C. The inhibitory effect of the light was also shown by alcohol experiments. The increased stability of the radiated solutions can be more strikingly demonstrated by mixing a small amount of the radiated solution with a large amount of non-radiated solution, when it will be found that the mixture will not coagulate even though heated to 100°.

Reactions of cysteine, cystine and glutathione: M. X. Sullivan. When 5 cc of solutions of various amino acids and thio compounds are treated with 1 cc of a 0.5 per cent. solution of 1.2 naphthoquinone-4-sodium sulphonate and then with 5 cc of a 20 per cent. solution of sodium sulphite in N/4 NaOH, the cysteine (used as hydrochloride) alone gives a red color. Glutathione, both in the oxidized and reduced form, failed to give the reaction. Cystine gave the reaction slowly, due to the reduction to cysteine by the sulphite. When the solutions of amino acids and of various thio compounds are treated with the naphthoquinone and then with one tenth volume of normal NaOH there speedily develops a color varying from reddish orange to dark brown, dependent on the concentration of the amino acids. Of the colors thus formed that given by cysteine is the only one not reduced to yellowish by sodium hydrosulphite $Na_2S_2O_4$.